

FIG. 20 is a perspective view illustrating principally the different positions to which a receptor unit 2 can be moved in relation to a patient support table 1 when using the carrier and bearing mechanisms illustrated in FIGS. 12-19. Some 5 of the positions shown by way of example in FIG. 20 correspond to the positions referenced A, C, F in FIGS. 1 and 2. However, FIG. 20 shows a number of further positions which have been made possible because the receptor unit 10 can be moved in the X-direction and also possibly in the Y-direction, and because the receptor unit can also be swung down from a horizontal position and adjusted about a vertical axle for operating with an angle beam path.

Other modifications of the invention are possible within the scope of its basic concept as expressed in the following 15 Claims. For instance, the receptor unit may be accommodated in a frame which carries a table top, for instance a "floating" table top, i.e. a table top that is movable in the X-direction and/or the Y-direction.

The trend towards the development of filmless systems in 20 which images are produced and stored electronically is particularly well served by the inventive method and the inventive patient support table. Because of the complexity of such electronic systems and because of the cost of such 25 systems in which the receptor is connected directly to an evaluating unit, it is of extreme importance that the receptor can be used universally, therewith avoiding loose film cassettes, for instance.

I claim:

1. A method relating to radiation sensing using a beam source which can be adjusted for at least one of horizontal, 30 vertical and angled beam paths and a receptor unit (2) which can be swung out and up from a position beneath a top surface of a table to a vertical position on one side of and parallel with the table comprising the steps of:
 - (1) swinging the receptor unit (2) to at least one of two alternative positions outside each table side edge; and
 - (2) swinging the receptor unit (2) upwards to a vertical position about a horizontal axle (10);
 wherein said receptor unit being swung through the medium of pivot centres (11, 12), has vertical axles in the region of 40 each side edge of the table (1).
2. A method according to claim 1, further comprising the step of:

45 positioning respective pivot centres (11, 12) in an X-direction, which is parallel to a longitudinal direction of the table, and in a Y-direction, which is parallel to a transverse direction of the table,

 wherein centering of the beam source in the X-direction will be the same with both horizontal and vertical beam paths.
3. A method according to claim 1, further comprising the 50 step of:

55 swinging the receptor unit (2) outwardly to at least one of said alternative outwardly and upwardly swung positions to a position in which said unit is perpendicular to the X-direction.
4. A method according to claim 1, further comprising the step of:
 - (1) moving the receptor unit in a X-direction with corresponding, automatic movement of the beam source; and
 - (2) adjusting said source for horizontal beam path onto the receptor unit subsequent to having swung said unit outward and upward outside a side edge of the table.
5. A method according to claim 1, further comprising the 65 step of:

65 supporting the receptor unit (2) with the aid of a support element (15) mounted on at least one of a frame

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structure which is fixed relative to the table, and on a carriage which is movable in a X-direction in relation to said table.

wherein the receptor unit can be moved in the Y-direction relative to the element (15). 5

6. A method according to claim 5, further comprising the step of:

at least one of raising and lowering the receptor unit from an outwardly swung, horizontal position on one side of the table (1) to a vertical position at least one of above 10 and beneath the table, by pivoting said receptor unit about mutually parallel axes (10; 21) located on mutually different levels.

7. A method according to claim 1, further comprising the step of: 15

pivoting the receptor unit (2) in an outwardly swung and upwardly swung vertical position about a central, vertical axle (22) for operating with an angled beam path.

8. A patient support table equipped with a receptor unit 20 and intended for radiation sensing, wherein the receptor unit (2):

is supported for movement in a X-direction, which is parallel to the longitudinal direction of the table;

is adapted for coaction with a beam source which is 25 movable in the X-direction, a Y-direction, which is parallel to the transverse direction of the table and in a Z-direction;

is capable of being swung about a horizontal axle; and is capable of being swung out and up about a vertical and 30 horizontal axle from a position beneath a top surface of the table to a position on one side of and parallel with the table; and

is carried by arms (7, 9) which are joined together, by a 35 link (8), through the medium of pivot centres (11, 12) having vertical axes in the region of each side edge of the table (1), to enable the receptor unit (2) to be swung out to alternative positions on each side of the table (1) and swung up to a position in which the receptor unit is parallel with the table for operating with a horizontal beam path, this latter movement of the receptor unit being possible by virtue of a horizontal hinge (10) which connects said unit to one (9) of said arms. 40

9. A table according to claim 8, wherein the receptor unit (2) can be swung from the position for operation with a 45 horizontal beam path to a position perpendicular to the table, through the medium of a vertical axle.

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10. A table according to claim 9, wherein the vertical axle constitutes one (11) of said pivot centres (11, 12).

11. A table according to claim 8, wherein the lengths of the arms (7, 9) and the link (8) allow the receptor unit (2) to take a position for operation with a centered beam path without being moved in the X-direction from its original position (position A) beneath a top surface of the table (1), irrespective of from which side the receptor unit is swung outwards and upwards.

12. A table according to claim 8, wherein the receptor unit (1) and its associated arms (7, 9), link (8) and pivot centres (11, 12) are supported by a carriage mounted on the underside of the table (1) and movable in the X-direction.

13. A table according to claim 8, wherein the table top is movable in at least one of the X-direction and the Y-direction, and the receptor unit (1) is mounted in a frame carried by said table top.

14. A table according to claim 12, wherein the carriage includes an element (15) having means (16-19) for guiding movement of a further element (18) journalled to one (7) of the arms (7, 9), wherein the other (9) of said arms carries a block (20) in which a plate (24) carrying the receptor unit (20) is journalled for pivotal movement about a horizontal axle (10).

15. A table according to claim 14, wherein the block (20) has a further axle (21) which is parallel with said horizontal axle (10) and on which the plate supporting said receiver receptor unit is pivotally mounted.

16. A table according to claim 15, wherein the receptor unit (2) is connected to the plate (24) by means of an axle (25) which extends perpendicularly to the plate and about which the receptor unit can be swung for operation with an angled beam path.

17. A table according to claim 8, wherein at least one of the table and the receptor unit includes an operating device, for manoeuvering the linear movement and pivotal movement of the receptor unit (2) in relation to the patient support table.

18. A table according to claim 12, wherein the carriage includes an operating device, for manoeuvering the linear movement and pivotal movement of the receptor unit (2) in relation to the patient support table.

19. A table according to claim 13, wherein the frame includes an operating device, for manoeuvering the linear movement and pivotal movement of the receptor unit (2) in relation to the patient support table.

20. An x-ray system electronically forming x-ray images, comprising:
a patient table having a top elongated in a head-feet direction and left and right sides;
an articulated structure supported at a selected position relative to the patient table for
selective relative movement between at least portions of said articulated structure
and the table top;
an x-ray receptor producing x-ray images electronically in response to receipt of x-rays;
said articulated structure supporting the x-ray receptor, but not an x-ray source, for
selective movement to and maintenance of each of a position of the receptor under
the patient table top for through-table imaging, a position of the receptor at the left
side of the patient table, and a position of the receptor at the right side of the
patient table;
wherein when in either of said positions at the left and at the right side of the patient
table, the x-ray receptor is selectively in each of a position substantially along the
patient table top and a position transverse to the patient table top;
wherein when in said position transverse to the patient table top, the x-ray receptor is
selectively in each of a position generally above the patient table top and a
position generally below the patient table top; and
wherein when in said position generally above the patient table top, the receptor is
selectively in each of a position substantially parallel to the length of the patient
table top, a position substantially normal to the length of the patient table top, and
a position angled to the length of the patient table top.

21. A system as in claim 20 in which the articulated structure comprises a first arm, a second
arm, a link between the first and second arms, said first arm being supported by the
patient table and pivoting about a vertical axis, and said link pivoting relative to at least
one of the arms about a vertical axis, and a horizontal hinge coupling the second arm and
the x-ray receptor.

22. A system as in claim 20 in which said articulated structure comprises a carriage element
supported for movement along the table top length.

23. A system as in claim 22 in which said articulated structure comprises a carriage element further supported for movement across the table top length.
24. A system as in claim 20 including a carriage supported for movement along the length of the table top. said carriage supporting a carriage element for movement across the length of the table top to thereby selectively move the x-ray receptor along and/or across the length of the table top.
25. A system as in claim 20 in which the x-ray receptor is substantially normal to the table top when in the position transverse to the table top.
26. A system as in claim 20 in which said x-ray receptor is substantially parallel to the table top when in said position for through-table imaging.
27. A system as in claim 20 in which the table supports the articulated structure.
28. A system as in claim 20 in which the table top supports the articulated structure.
29. A system as in claim 20 including a stand positioned at a selected location relative to the table and supporting the articulated structure
30. A system as in claim 20 including a source of x-rays movable between positions corresponding to at least some of said positions of the x-ray receptor to direct said x-rays thereto.
31. A system as in claim 20 including a frame carrying said table top as a floating table top movable in at least one of the directions along the length and across the length of the table top relative to the frame, said frame accommodating said x-ray receptor.
32. An x-ray system comprising:
a patient table having a top extending in a head-feet direction and left and right sides;
an x-ray source selectively producing a beam of x-rays;

an x-ray receptor producing x-ray images electronically in response to an impinging two-dimensional distribution of x-ray intensities within said beam of x-rays; and
an articulated structure supporting the x-ray receptor, but not the x-ray source, for
selective movement relative to the patient table top between positions including
each of a position under the patient table top for through-table x-ray imaging with
the x-ray source above the table top, a position at the left side of the patient table
and transverse to and generally above the patient table top for cross-table x-ray
imaging with the x-ray source generally above and at the right side of the patient
table, and a position at the right side and transverse to the patient table top for
cross-table imaging with the x-ray source generally above and at the left side of
the patient table;

wherein each of said positions of the x-ray receptor transverse to the patient table top and
at the left and right sides of the patient table for cross-table x-ray imaging includes
a position in which the x-ray receptor is selectively in a position substantially
parallel to the length of the patient table top for cross-table lateral x-ray imaging
and a position in which the x-ray receptor is angled to the length of the patient
table for cross-table oblique x-ray imaging.

33. A system as in claim 32 in which the articulated structure is mounted for selective movement along the head-feet direction to move said positions of the x-ray receptor in said direction.
34. A system as in claim 33 in which the articulated structure includes an element supporting the x-ray receptor and mounted for selective left-right movement relative to the table top.
35. A system as in claim 32 in which said articulated structure further supports the x-ray receptor for selective movement to a position to the left and right side of and generally parallel to the table top for extremity imaging.
36. A system as in claim 35 in which when in said position to the left and right side of and generally parallel to the table top, the x-ray receptor is depressed relative to the table top.

37. A system as in claim 32 in which said articulated structure further supports the x-ray receptor for selective movement to a position to the left or right side of and transverse to the table top for chest imaging.
38. A system as in claim 32 in which the table supports the articulated structure.
39. A system as in claim 32 in which the table top supports the articulated structure.
40. A system as in claim 32 including a stand or frame supporting the articulated structure.
41. A system as in claim 32 in which said patient bed comprises a frame carrying said table top and accommodating said x-ray receptor, wherein said table top comprises a floating table top.
42. A system as in claim 41 in which the floating table top is mounted for selective movement along at least one of the head-feet direction and a left-right direction.
43. A system as in claim 42 in which said floating top is mounted for selective movement in each of said head-feet and left-right directions.
44. An x-ray system electronically forming x-ray images, comprising:
a patient table having a top with left and right sides;
an x-ray receptor for producing x-ray images electronically; and
an articulated structure supporting the x-ray receptor, but not an x-ray source, for
selective relative movement between the table and the structure to selectively
position the x-ray receptor at each of a position at the left side of the patient table
for cross-table imaging of a patient on the table top and a position at the right side
of the patient table for cross-table imaging from the left side of the patient, said
movement taking place without moving the patient or the patient table to
accomplish the movement;
said articulated structure having a portion remaining at a fixed position relative to the
table top in the course of said movement.

45. A system as in claim 44, in which the articulated structure further supports the x-ray receptor for selective movement to a position at least at one of the left and right sides of the patient table for cross-table oblique imaging from the other one of the left and right sides of the table top.
46. A system as in claim 44 in which the x-ray receptor comprises an operating unit initiating receptor locking and release operations.
47. A system as in claim 46 in which said operating unit moves with the x-ray receptor between said positions of the receptor and is accessible to an operator from the side of the patient table top at which the receptor is positioned.
48. A system for positioning an x-ray receptor for diagnostic protocols comprising: a filmless x-ray receptor producing x-ray images in response to x-rays impinging thereon; an x-ray source emitting a beam of x-rays; a patient table for supporting a patient between the source and receptor; an articulated structure supporting the x-ray receptor, but not the x-ray source, for selective motion relative to the table to respective positions for a variety of x-ray protocols comprising at least a position for through-table imaging with the x-ray beam substantially vertical and the receptor under the table, and a position for cross-table lateral imaging with the x-ray beam being substantially horizontal and the receptor being selectively at the right side and the left side of the patient; wherein said motion of the x-ray receptor maintains source-receptor centering at said positions and does not require moving the patient; and wherein a portion of said articulated structure remains at a fixed position relative to the table during said motion.
49. A system as in claim 48 in which the table has a width in a left-right direction and a length, and the articulated structure supports the x-ray receptor for selective motion along the length and across the width of the table.

50. A system as in claim 49 including a handgrip for manually moving the x-ray receptor between said positions.

51. A system for positioning an x-ray receptor for diagnostic protocols comprising: an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having a length and a width; and
an articulated structure supporting the x-ray receptor, but not an x-ray source, for selective motion relative to the table to respective positions for a plurality of x-ray protocols comprising at least a position for through-table imaging with the receptor under the table, a position for cross-table lateral imaging with the receptor at least at one side and generally above and along the length of the table, and a position for cross-table oblique imaging with the receptor at least at one side of the table and generally above and angled relative to the length of the table; and
supports for the table and articulated structure;
wherein at least a portion of the articulated structure remains at a fixed position relative to the patient table during said motion.

52. A system as in claim 51 in which said position for cross-table imaging includes a position for cross-table imaging at each side of the table.

53. A system for positioning an x-ray receptor for diagnostic protocols comprising: an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having a length and a width; and
an articulated structure supporting the x-ray receptor for selective motion relative to the table to respective positions for a plurality of x-ray protocols comprising at least a position for through-table imaging with the receptor under the table, a position for cross-table imaging with the receptor at least at one side and generally above to the table and extending along a direction non-normal to the length of the table,

and a position for imaging of a seated patient or the knees of a standing patient with the receptor at least at one side of the table and generally below the table;
and
supports for the table and articulated structure.

54. A system as in claim 53 in which said position for cross-table imaging comprises a position for cross-table lateral imaging with the receptor extending substantially along the length of the table.
55. A system as in claim 53 in which said position for cross-table imaging comprises a position for cross-table oblique imaging with the receptor extending at an angle to the length of the table.
56. A system as in claim 51 in which said position for cross-table imaging includes a position for cross-table imaging at each side of the table.
57. A system for positioning an x-ray receptor for diagnostic protocols comprising:
an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having a length and a width; and
an articulated structure supporting the x-ray receptor, but not an x-ray source, for selective motion relative to the table to respective positions for a plurality of x-ray protocols comprising at least a position for through-table imaging with the receptor under the table, a position for cross-table imaging with the receptor at least at one side and generally above the table and extending in a direction non-normal to the length of the table, and a position for imaging of a patient with the receptor at least at one side of the table and generally above the table and extending away from the table in a direction substantially normal to the length of the table; and
supports for the table and articulated structure.

58. A system as in claim 57 in which said non-normal direction is a direction extending along the length of the table.
59. A system as in claim 57 in which said non-normal direction extends at an angle to the length of the table.
60. A system as in claim 57 in which said position for cross-table imaging includes a position for cross-table imaging at each side of the table.
61. A system for positioning an x-ray receptor for diagnostic protocols comprising: an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having a length and a width; and
an articulated structure supporting the x-ray receptor, but not an x-ray source, for selective motion relative to the table to respective positions for a plurality of x-ray protocols comprising at least a position for through-table imaging with the receptor under the table, a position with the receptor at least at one side and generally above to the table and extending away from the table, and a position with the receptor at least at one side of and generally below the table; and
supports for the table and articulated structure.
62. A system for positioning an x-ray receptor for diagnostic protocols comprising: an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having a length and sides spaced in a direction transverse to the table length; and
an articulated structure supported by the table and supporting the x-ray receptor for selective motion relative to the table to respective positions for a plurality of x-ray protocols comprising at least a position for cross-table imaging with the receptor being selectively at each side of the table; and
a support for the table.

63. A system as in claim 62 in which said positions include a position for cross-table lateral imaging and a position for cross-table oblique imaging at each side of the table.

64. A system for positioning an x-ray receptor for diagnostic protocols comprising: an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having a length and sides spaced from each other in a width direction; and
an articulated structure supported by the table and supporting the x-ray receptor for selective motion relative to the table to respective positions for a plurality of x-ray protocols comprising at least a first position for cross-table imaging with the receptor at least at one side of the table and extending in a direction non-normal to the length of the table, and a second position for imaging with the receptor at least at one side of the table and extending in a direction away from the table and normal to the length of the table; and
a support for the table;
wherein at least one of said first and second positions selectively includes a position at each side of the table.

65. A system as in claim 64 in which said non-normal direction is a direction extending along the length of the table.

66. A system as in claim 64 in which said non-normal direction extends at an angle to the length of the table.

67. A system as in claim 64 in which said position for cross-table imaging includes a position for cross-table imaging at each side of the table.

68. A system for positioning an x-ray receptor for diagnostic protocols comprising: an x-ray receptor producing x-ray images electronically in response to x-rays impinging thereon;
a patient table for supporting a patient between the source and receptor, said table having

a length and a width; and
an articulated structure supported by the table and supporting the x-ray receptor for
selective motion relative to the table to respective positions for a plurality of x-ray
protocols comprising at least a position for cross-table imaging with the receptor
at least at one side of and generally above the table and extending in a direction
non-normal to the length of the table, and a position for imaging with the receptor
at least at one side of the table and generally below the table; and
a support for the table.

69. A system as in claim 68 in which said non-normal direction is a direction extending along
the length of the table.
70. A system as in claim 68 in which said non-normal direction extends at an angle to the
length of the table.
71. A system as in claim 68 in which said position for cross-table imaging includes a position
for cross-table imaging at each side of the table.
72. A system as in claim 68 in which said position with the receptor generally below the table
comprises a position in which the receptor extends along the length of the table.
73. A system for positioning an x-ray receptor for diagnostic protocols comprising:
an x-ray receptor producing x-ray images electronically in response to x-rays impinging
thereon;
a patient table for supporting a patient between the source and receptor, said table having
a length and a width; and
an articulated structure supported by the table and supporting the x-ray receptor for
selective motion relative to the table to respective positions for a plurality of x-ray
protocols comprising at least a position with the receptor at least at one side and
generally above to the table and extending away from the table in a direction
normal to the length of the table, and a position for imaging with the receptor at
least at one side of the table and generally below the table; and

a support for the table.

74. A system as in claim 73 in which said position with the receptor extending away from the table includes a position at each side of the table.
75. A system as in claim 73 in which said position with the receptor generally below the table comprises a position in which the receptor extends along the length of the table.
76. A method of x-ray imaging with a filmless x-ray receptor producing x-ray images electronically comprising:
providing an x-ray source selectively emitting a beam of x-rays, a filmless x-ray receptor for producing x-ray images electronically, and a patient table top for supporting a patient between the source and receptor;
moving the x-ray source and an articulated structure supporting the x-ray receptor, but not the source, between the following positions of the receptor and corresponding positions of the source in which the x-ray beam is directed at the receptor: a position under the table top for through-table imaging, a position at the left side of the table top, and a position at the right side of the table top;
wherein each of said positions at the left and at the right side of the patient table top includes a position in which the x-ray receptor is substantially along the patient table top and a position in which the x-ray receptor is transverse to the patient table top;
wherein when in said position transverse to the patient table top, the x-ray receptor is selectively in each of a position generally above the patient table top and a position generally below the patient table top; and
wherein when in said position generally above the patient table top, the receptor is selectively in each of a position substantially parallel to the length of the patient table top, a position substantially normal to the length of the patient table top, and a position angled to the length of the patient table top.
77. A method of x-ray imaging with an x-ray receptor producing x-ray images electronically comprising:

providing an x-ray source selectively emitting a beam of x-rays, an x-ray receptor selectively producing x-ray imaged electronically, and a patient table top supporting a patient between the source and receptor;
moving the x-ray source and an articulated structure supporting the x-ray receptor, but not the source, between a position under the table top for through-table imaging in which the x-ray source is above the patient, a position at the left side of the table top in which the x-ray source is to the right of the patient, and a position at the right side of the table top in which the x-ray source is to the left of the patient;
wherein in each of said positions the x-ray source is centered on the receptor to direct the x-ray beam at the x-ray receptor for imaging the patient with x-rays.

78. A method as in claim 77 including moving the x-ray source between positions corresponding to said positions of the x-ray receptor while maintaining the source centered on the receptor.
79. A method as in claim 77 in which said moving comprises moving the x-ray receptor along the length of the patient with corresponding automatic movement of the x-ray source.
80. A method as in claim 52 comprising manually moving the receptor between said positions thereof while said articulated structure supports the receptor.